Case Characterization and Perceptions of Athletic Trainers Regarding Medical Disqualification Following Concussion

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Context: Medical disqualification (MDQ) following concussion is a challenging decision clinicians may encounter with little evidence-based guidance.

Objective: To (1) describe the MDQ following concussion cases athletic trainers (ATs) have been involved in, (2) describe beliefs about MDQ following concussion, and (3) explore factors that ATs believed should be involved in the MDQ following concussion process.

Design: Mixed methods.

Setting: Online cross-sectional survey with follow-up semistructured interviews.

Patients or Other Participants: Athletic trainers (n = 502) employed at the collegiate setting completed a survey (completion rate = 82.3%, n = 413/502; men = 175, 34.9%; women = 235, 46.8%, prefer not to answer = 4, 0.8%; no response = 88, 17.5%; age = 35.3 ± 10.8 years). Twenty participants were also interviewed (men = 13, 65.0%; women = 7, 35.0%; average age = 40.7 ± 11.0 years).

Data Collection and Analysis: Participants completed a cross-sectional survey comprised of 3 sections of MDQ experience and specific case information, MDQ beliefs, and demographic items. We also interviewed participants who completed the survey

and indicated involvement in at least 1 MDQ following a concussion case. We addressed aims 1 and 2 using descriptive statistics and aim 3 with a 5-cycle content analysis.

Results: Nearly half of respondents had been involved in an MDQ case following concussion (49.0%, n = 246; not involved = 51.0%, n = 256). Athletic trainers who had been involved in at least 1 MDQ case were involved in an average of 2.3 ± 1.9 cases (n = 241). Participants often described many factors that they believed should influence the MDQ decision, including sport type, concussion history and recovery, health-related quality of life, and academic performance.

Conclusions: Our findings highlight that nearly half of participants were involved in an MDQ case following concussion and navigated this process without guidelines. Given this, multiple factors were considered to evaluate the patient's well-being holistically. The number of ATs involved in MDQ cases following concussion and factors that guided this process warrant further research to develop evidence-based recommendations that assist clinicians in these difficult decisions.

Key Words: sport retirement, mild traumatic brain injury, sport participation discontinuation

Key Points

- Nearly half of our sample had been involved in at least 1 medical disqualification (MDQ) case following concussion, with athletic trainers being involved in an average of 2 MDQ cases.
- Participants believed that a multidisciplinary team should be involved in MDQ cases with team physicians, studentathletes, and sport-specific athletic trainers most frequently selected, whereas parents/guardians were ranked sixth.
- Many factors were considered in the MDQ following the concussion decision-making process, including sport
 contact level, concussion history and recovery duration, long-term health consequences, health-related quality of
 life, and disclosure, among others.

oncussion is one of the most challenging injuries that sports medicine professionals encounter, as it can involve difficult decisions regarding diagnosis, management, and return to activity.¹ As with any injury, challenges arise with determining when continued sport participation may no longer be recommended. Concussions are among the most common medical disqualification (MDQ) injuries in a wide range of high school sports, including boys' football, ice hockey, lacrosse, and soccer as well as girls' basketball, field hockey, lacrosse, soccer, and softball.² However, little is known regarding the MDQ following concussion decision-making process among collegiate student-athletes.

To help provide sports medicine professionals guidance in MDQ following concussion, the American Medical Society

for Sports Medicine position statement declares, "There are no evidence-based guidelines for disqualifying/retiring an athlete from a sport after a concussion. Each case should be carefully deliberated and an individualized approach to determining disqualification taken."3 Although these recommendations suggest taking an individualized approach, the following factors have been proposed as considerations for MDQ following concussion: structural abnormalities in neuroimaging, multiple lifetime concussions, persistent diminished academic or workplace performance, persistent postconcussive symptoms, prolonged recovery courses, and perceived reduced threshold of sustaining recurrent concussions.⁴⁻⁸ However, these recommendations have been based predominantly on clinical opinion or lowerquality evidence.⁵-8 Recent findings have also found that a higher proportion of student-athletes with a greater concussion and headache history, more severe and immediate concussion presentation, and longer concussion recovery outcomes were medically disqualified than those who were not medically disqualified.⁹ However, these findings do not examine the many psychological and social nuances that may play a role in the MDQ following concussion decision-making process. Additionally, concussion may result in impairments to cognition, vision, mood, postural control, and/or health-related quality of life, among others.^{3,10,11} Although these impairments are typically short lived,¹¹ some individuals have persistent symptoms that may take months to recover from or have increased risk for repeat concussions, making clinicians and student-athletes often consider MDQ.⁴ It has been noted that athletic trainers' (ATs') views of athletic achievement influenced when MDO is discussed but not what reasons, such as concussion history or other well-being factors, led them to initiate those discussions or descriptions of the experiences themselves.9,12 Athletic trainers are an important part of the concussion management team, and it is currently unknown which factors ATs consider when making decisions about MDQ following concussion. Therefore, the purpose of our study was to (1) describe the MDQ following concussion cases ATs have been involved in, (2) describe the beliefs of the AT regarding MDQ following concussion, and (3) explore the factors that ATs believed should be involved in the MDQ following concussion process.

METHODS

Design

We used a convergent parallel mixed methods design. Convergent parallel designs include data being collected and analyzed separately and then combined to achieve triangulation.^{13,14} Triangulation is a qualitative research concept in which multiple methods are used to triangulate results about a topic, which is necessary to offset the biases associated with each method and counteract sources of error.^{14,15} Aims 1 and 2 were crosssectional, whereas aim 3 was conducted using qualitative research methods guided by a phenomenological philosophical framework. Phenomenology was the philosophical tradition guiding this research for aim 3, as it examines the lived experience.¹⁶ In this case, the lived experience in aim 3 is that of an MDQ following a concussion from career collegiate sport participation (ie, MDQ decided but not necessarily filed through the National Collegiate Athletic Association).

Participants

For aims 1 and 2, we recruited participants through a convenience sample of 6500 ATs contacted through the National Athletic Trainers' Association (NATA) Research Survey Service for survey completion in spring 2021. Participants were drawn from a diverse, nationwide sample and included if they were certified members of NATA providing clinical care in a collegiate setting. Exclusion criteria included individuals who were not ATs credentialed in their respective state or members of NATA.

For aim 3, we contacted ATs from aims 1 and 2 who indicated that they had been involved in at least 1 MDQ case and demonstrated willingness to complete a follow-up interview (criterion-based sampling). In a phenomenological approach, one would anticipate interviewing no more than 25 participants to achieve data saturation.¹⁶

Instrumentation

Following an extensive literature search, we determined that no validated surveys existed regarding the decision-making processes of MDQ following concussion; therefore, we created a new survey to answer aims 1 and 2. Face and content validity were assessed by content experts. Following face and content validation, we calculated a content validity index (CVI) with 6 content experts (3 concussion experts, 1 biostatistician, and 2 clinicians) rating the relevance of each survey item, excluding demographics.¹⁷ Reviewers were instructed to rate each item, excluding demographics, based on how each item was relevant to the underlying construct (1 = not relevant, 2 =somewhat relevant, 3 = quite relevant, 4 = highly relevant).¹⁷ The CVI-scale score was 0.88 for the entire measure, which is above the acceptable value of 0.80 for 6 raters.¹⁸ However, 3 individual items were deemed not relevant by raters with a CVI-item score below 0.78.19 Thus, the 3 items were removed, and the new CVI-scale score was 1.00, indicating perfect scale and rater agreement. Because the survey was used to describe ATs' beliefs regarding what should be included when considering MDQ following concussion, it was determined from a statistical consultation that a reliability analysis was not warranted.20,21

The final survey included 3 sections of MDQ experience and specific case information (22 items maximum; sample survey item: "How many medical disqualification cases following concussion have you been involved in?"), MDQ beliefs (18 items maximum; sample survey item: "What do you believe should be considered when making the medical disqualification decision following concussion?"), and demographic items (13 items maximum). Item total varied based on branching logic (see Supplemental Table, available online at https://dx.doi.org/10.4085/1062-6050-0567.23). Additionally, a variety of survey responses were used, including binary, open-ended, multiselect, number bar, rank order, and Likertscale. The MDQ experience section included asking participants if they had encountered an MDQ case. If participants selected yes, they continued to answer specific items such as how many cases they have been involved in and specific items for each case including who was involved and so on. The MDQ beliefs section included item examples such as "How many concussions do you consider to be too many before MDQ should be considered?" and "Do you believe sex should be considered when contemplating MDQ following concussion?" Examples of demographic items included age, years of experience, etc.

We developed semistructured interview protocols that included a specific series of 11 open-response questions to address the guiding questions for aim 3. Once the interview protocols were developed, a qualitative expert, as well as a content expert, reviewed it to ensure face validity. We asked participants to focus on MDQ cases as related to concussion only. The interview protocol was pilot tested with 2 individuals from the participant group who met the inclusion criteria but who did not participate during data collection. Pilot participants provided the feedback that we should instruct participants to review cases before the interview. No other modifications to the interview protocol were made.

Procedures

Participants who met the inclusion criteria were contacted via email through the NATA Research Survey Service for aims 1 and 2. Participants answered the MDQ case and specific case information if they had been involved in at least 1 MDQ case following concussion and if they would like to participate in follow-up interviews. If participants had not participated in an MDQ case following concussion, they were surveyed on items related to what they believed should be considered in potential sport disqualification following concussion. Participants were able to access the survey for 4 weeks, with 2 reminders being sent 1 week apart. The survey required about 10 to 15 minutes to complete.

Following survey distribution and completion, we contacted those participants who expressed willingness to participate in follow-up interviews for aim 3. Interviews of ATs used criterion-based sampling of those who had been involved in at least 1 MDQ case following concussion. We sent emails regarding interest in interview participation. Written and verbal consent was obtained before data collection. We obtained general participant demographics before digitally audio recording the interview via Zoom (Zoom Video Communications, Inc). Data collection occurred until data saturation was achieved. Interviews were anticipated to require approximately 45 minutes to 1 hour, and participants were compensated \$75 for their time. Audio recordings were transcribed using Zoom. Transcripts were checked for accuracy by a research assistant, who listened to the recordings and read/modified the transcripts simultaneously.

Data Analysis and Management

For demographic findings and aims 1 and 2, we calculated descriptive statistics, including means, SDs, medians, ranges, and frequencies. In general, a content analysis was performed to examine the narratives provided by participants for aim 3. Specifically, a 5-cycle process was completed as described by Anderson and Wertz et al.^{22,23} Cycles 1 and 2 were completed through an introduction and literature review to clarify the topic of interest in the course of writing this manuscript. Cycle 3 involved collecting and examining data from interviews for meaningful units and codebook creation. To create a codebook, 4 transcripts were randomly selected and read among the author group, looking for repeating and/or interesting ideas. The research team (M.L.W.R., T.C.V.M., and J.D.S.) met using Zoom to discuss any identified meaningful units and to create an initial codebook with themes and subthemes. The initial codebook was then used to code 4 different transcripts, and the research team met again to discuss coding line by line. Following this process, the final codebook was created. The finalized codebook was then applied to all transcripts. Cycle 4 involved synthesizing the findings with the existing literature, whereas

Cycle 5 encompassed the development of final interpretations of the findings. Outcomes from Cycles 4 and 5 are included in the discussion of this manuscript.

Data trustworthiness was evaluated in Cycle 3. First, credibility was assessed through member checks.²⁴ To perform member checks, each participants' interview transcript was emailed to the participant, who had the opportunity to review the transcript. The participant checked for any areas that they wished to further describe within the instructed bounds of not changing the transcript itself.²⁴ This allowed for data to be assessed by the participant, supplemented by any additional information that the individual provided following transcript review, while preserving the original data. In addition, dependability and confirmability of the data were assessed by an external reviewer. The external reviewer received the interview guide, a small number of uncoded transcripts, the finalized codebook, and the corresponding coded transcripts. The external reviewer read through all materials and determined whether there was agreement between their review and the codebook created and implemented by the research team.

RESULTS

For aims 1 and 2, 502 participants completed at least 1 portion of the survey, with 413 completing the survey in its entirety (completion rate = 82.3%). Participant demographic variables are provided in Table 1. Athletic trainers included in our sample had been providing athletic health care for an average of 12.5 ± 10.5 years and managed an average of 7.5 ± 5.7 concussion cases annually. Nearly half of our sample had been involved in at least 1 MDQ case from career collegiate sport participation following concussion (n = 246, 49.0%). Athletic trainers who had been involved in at least 1 MDQ case following concussion had involvement in an average of 2.3 ± 1.9 cases (n = 241).

To address aim 3, we interviewed 20 participants (men = 13, 65.0%; women = 7, 35.0%; average age = 40.7 \pm 11.0 years) until data saturation was achieved. Participants had been practicing clinicians for 17.6 \pm 10.1 years with 11.3 \pm 10.9 years at their current institution. Interview participants managed an average of 9.7 \pm 6.8 to 12.6 \pm 8.5 concussion cases annually (some participants provided a range; means and SDs were calculated based on end ranges) and had been involved in 3.6 \pm 3.0 to 4.0 \pm 3.5 MDQ following concussion cases (some participants provided a range; means and SDs were calculated based on end range).

MDQ Following Concussion Cases

Nearly half of respondents had been involved in an MDQ case following concussion (49.0%, n = 246/502; not involved = 51.0%, n = 256/502), with ATs being involved in an average of 2.3 \pm 1.9 cases (n = 241). Athletic trainers reported that MDQ patients had 4.6 \pm 1.9 concussions, on average. Respondents from our survey sample were involved in a total of 563 MDQ cases following concussion. Individuals included in the MDQ decision-making process most often included the student-athlete (72.6%, n = 409/563), followed by the team physician (69.3%, n = 390/563), head AT (60.6%, n = 341/563), sport-specific AT (53.3%, n = 299/563), parents/guardians (44.9%, n = 253/563), neurologist (40.1%, n = 226/563), coach (28.4%, n = 160/563), neuropsychologist (14.0%, n = 79/563), primary care physician

Table 1. Participant Demographic Results^a

Characteristic	n	Percentage (Based on Entire Sample), %	Percentage (Based on Only Those Who Answered Item), %
Sex			
Men	175	34.9	42.3
Women	235	46.8	56.8
Prefer not to respond	4	0.8	1.0
No response	88	17.5	-
Race			
American Indian/Alaska Native	0	0	0
Asian	13	2.6	3.1
Native Hawaiian/Pacific Islander	3	0.6	0.7
African American/Black	7	1.4	1.7
White	379	75.5	91.8
Unknown	11	2.2	2.7
No response	89	17.7	-
Ethnicity			
Hispanic/Latino	18	3.6	4.4
Not Hispanic/Latino	378	75.3	92.0
Unknown	15	3.0	3.6
No response	91	18.1	-
Setting			
NCAA Division I	168	33.5	40.5
NCAA Division II	68	13.5	16.4
NCAA Division III	89	17.7	21.4
NAIA	39	7.8	9.4
Community college	35	7.0	8.4
Other	16	3.2	3.9
No response	87	17.3	-
Highest level of educational degree			
Bachelor's	42	8.4	10.1
Master's	305	60.8	73.3
Clinical doctorate (eg, DAT, DPT)	19	3.8	4.6
Academic doctorate (eg, PhD, EdD)	46	9.2	11.1
Medical doctor	0	0	0
Other	4	0.8	1.0
No response	86	17.1	-

Abbreviations: NAIA, National Association of Intercollegiate Athletes; NCAA, National Collegiate Athletic Association; –, not calculated as percentage based on only those who completed the item.

^a The mean age (SD) of the population was 35.3 (\pm 10.8) years.

(12.4%, n = 70/563), sport psychologist (8.2%, n = 46/563), other (3.2%, n = 18/563), and teammates (0.01%, n = 6/563). Respondents who indicated "other" noted involvement from athletic directors (16.7%, n = 3/18), psychologists/counselors (16.7%, n = 3/18), school support staff (11.1%, n = 2/18), concussion specialists (5.6%, n = 1/18), siblings (5.6%, n = 1/18), neuromechanists (5.6%, n = 1/18), and faculty who specialize in concussion research (5.6%, n = 1/18).

MDQ Following Concussion Beliefs

Percentages, frequencies, and importance ranking for each item related to MDQ following concussion beliefs are included in Table 2. Respondents believed most frequently that team physicians, student-athletes, and sport-specific ATs should be involved in the MDQ following concussion decision-making process (Table 2). The ATs in this study who answered the item believed that 5 concussions were too many before MDQ should be considered (median = 5, interquartile range = 3.00-6.00, n = 433). Approximately 77% of respondents believed that sport contact level should be considered in the MDQ decision-making process, with contact/collision considered the most influential in the MDQ decision-making process, followed by limited contact and noncontact. Nearly 78% of participants

believed that sex should not be considered when contemplating MDQ following concussion. Athletic trainers most frequently perceived that an athlete's concussion history should be considered in the MDQ decision (87.1%, n = 437), followed by long-term health (86.1%, n = 432), medical professionals' opinions and recommendations (85.7%, n = 430), and long-term health-related quality of life (85.7%, n = 430). Additionally, respondents believed that the athlete's concussion history should be most influential, followed by recovery time and athlete preference.

Perceived Factors to Include in the Decision-Making Process

Following analysis, we discovered 6 overall themes. This manuscript focuses on the theme and subthemes for factors ATs use in the decision-making process. Athletic trainers described numerous factors involved in weighing the decision of MDQ for athletes. Factors included the number of concussions (both diagnosed and undiagnosed), long-term health consequences and future well-being, health-related quality of life, symptom severity, disclosure, academics, and length of recovery. Table 3 includes additional evidence for each subtheme associated with the theme.

Item	Item Response	2	Percentage (Based on Entire Sample, N = 502), %	Percentage (Based on Only Those Who Answered Item), %	Rank Order Item Response Most Influential in Decision	Percentage, % (<i>n</i>)
Who do you believe should be involved in the MDQ following the concussion decision-making process? (check all that apply; $n = 453$)	Team physician Student-athlete Sport-specific athletic trainer Neurologist Head athletic trainer Parent/guardian Neuropsychologist Sports psychologist Primary care physician Coach Other Teammates No response provided	448 408 404 365 365 360 241 174 165 122 122 100 100 49	89.2 81.3 81.3 77.7 72.5 72.5 72.5 19.9 19.9 9.8 9.8	9 9 0. 0 9 0. 0 9 0. 0 9 0. 0 9	Not rated by participants for order of importance	
Do you believe sport contact level should be considered when contemplating MDQ following concussions (ie, athletes who play football should be considered for MDQ more than cross-country athletes)? Do you believe sex should be considered when contemplating MDQ following concussion?	Yes No Missing Yes No Missing	386 67 67 69 390 390 390	76.9 13.3 9.8 12.0 10.4	85.2 14.8 86.7 86.7	 Collision/contact^a Limited contact Noncontact Females Males Eemales 	70.1 (352) 71.3 (358) 72.3 (363) 6.8 (34) 6.8 (34) 6.8 (34) 6.8 (31)
What do you believe should be considered when making the MDQ decision following concussion? (check all that apply; $n = 445$)	Athlete concussion history Long-term health Medical professionals' medical opinions and recommendations Long-term health-related quality of life Athlete concussion recovery time Injury impact on academic performance Abnormal neuroimaging (eg, positive CT scan) Reduced threshold to repeat injury injury impact on familial relationships or friendships Athlete performance Long-term career aspirations	437 437 430 410 378 378 378 378 378 2280 2280 2290 2290	87.1 86.1 85.7 85.7 79.7 75.3 60.2 55.8 47.8 47.8 21.9	98.2 97.1 96.6 89.9 84.9 51.5 53.9 24.7	 (2) Females (1) Athlete concussion history (2) Athlete concussion recovery time (3) Athlete preference (4) Parent/guardian preference (5) Coach preference (5) Coach preference (6) Long-term career aspirations (6) Long-term health (7) Parent/guardian preference (8) Institution protection (1) Financial hardship 	2.2 (11) 27.5 (138) 16.5 (83) 17.7 (89) 0.6 (3) 11.4 (57) 0.2 (1) 9.2 (46) 0.6 (3) 5.4 (27) 1.8 (9) 5.0 (25) 5.0 (25)

Table 2. Results for Medical Disqualification (MDQ) Following Concussion Beliefs Continued on Next page

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Table 2.

ltem	Item Response	и	Percentage (Based on Entire Sample, $N = 502$), %	Percentage (Based on Only Those Who Answered Item), %	Rank Order Item Response Most Influential in Decision	Percentage, % (<i>n</i>)
	Future potential in sport (eg,	62	12.4	13.9	(13) Parent/guardian	9.0 (45)
	professional career aspirations)				preference	
	Financial hardship	37	7.4	8.3	(14) Athlete concussion	13.5 (68)
					recovery time	
	Other	14	2.8	3.1	(15) Athlete concussion	12.7 (64)
					recovery time	
	Scholarship implications	13	2.6	2.9	(16) Financial hardship	2.6 (13)
	Coach performance	10	2.0	2.2	(17) Athlete concussion history	14.1 (71)
	Roster space (eg, the athlete	N	0.4	0.4	(18) Coach preference	8.2 (41)
	with concussion history				(19) Athlete concussion history	0.4 (2)
	removed from team so				(19) Injury impact on academic	0.4 (2)
	another athlete can have				performance	
	spot on team)				(19) Athlete performance	0.4 (2)
					(19) Parent/guardian	0.4 (2)
					preference	
					(19) Institution protection	0.4 (2)
	No response provided	57	11.4	I	Not applicable	
Abbreviation: CT computed tomography						

Abbreviation: Crit computed tomography. a Collision/contact sport examples: basketball, boxing, cheerleading, diving, football, gymnastics, field/ice hockey, lacrosse, rugby, soccer, water polo, and wresting. Limited contact sport examples: baseball, bicycling, fencing, high jump, pole vault, skiing, softball, volleyball, and weight lifting. Noncontact sport examples: badminton, bowling, crew, dance, discus, javelin, shot-put, golf, power lifting, running, swimming, tennis, and track.

Table 3. Evidence for Each Subtheme for Factors That Athletic Trainers Used in the Medical Disqualification Decision-Making Process

Subtheme	Evidence	
Number of concussions (diagnosed and undiagnosed)	a kid might sustain a third concussion or six[th] concussion overall or something like that. And you've already had the conversation with the kid and the parents after the fourth concussion and said, "Hey this number's getting high, we need to be careful about this," you know. And then, when it gets to the six[th] concussion you say, "All right look. You don't really need to play football anymore," and the kid goes, "Okay." Or the parent goes, "Okay." But, in general, the sheer number, and if you asked her you know how many of you reported and how many have gone hidden? I don't even think she could give you a straight answer which is scary.	
Long-term health consequences and future well-being	Quality of life and long-term life should be at the far and foremost of what we want to look at. The short- term goals to maybe return to an activity don't necessarily all the time outweigh the risk of long-term involvement. But we also have to know that for mental health and identity, we have to sort of balance that out, that short-term goal, they can participate in some way, shape, or form, we need to address that. But ultimately, we have to advocate for the long-term health and safety of our student-athlete.	
Health-related quality of life	I think there needs to be a conversation of, "Hey, you know, what are your future plans? Is this sport in your future plans? Or is this just something you enjoy doing?" And making it sound like you know, "Hey like we care about what you want to do." So then we've got into, "Or hey, like you know, this might not be the best for you to continue to do this sport, because we don't want to see you like lack in your guality of life and what you're able to do in the future." and then explain it to them.	
Symptom severity	Yes, they all had a lot of symptoms, lingering symptoms, or things like that There was stuff that was like, "Oh I can't turn my neck today. I can't not have a migraine. I've had a migraine for 20 days out of 21." Things like, "I can't learn like I'm supposed to do. I can't function in class. I've got these lingering symptoms that keep coming back and I'm trying to get healthy." Then, it affects their play. It affects them just sitting and watching a movie. Those are things that people shouldn't have to live with I think that's probably the biggest factor in approaching my team physician and saying, these symptoms they're there. They're from concussion. They could be from that, but they're lingering so long that now they can't study. They can't do their homework. They can't just go out to a restaurant for 3 hours, because the noise affects the way they feel, or things like that. I think those are the bigger things that would lead to the disqualification.	
Disclosure	Athletes states, "Well, I can get away with this many." Because they do; they do their research. It's the same I've seen with filling out the medical hardships. They'll do the research. They'll know enough to say, "Well, I got hurt last week. I know if I play in another game, I might not get a hardship, so let me wait to see if I get better or not." I think that's kind of a similar thing happening with concussions. "I know I've had 1 or 2. They were okay, but I know they'll freak out if I say I had 3 or more, so I'm not going to tell them I had a third one."	
Academics	The student-athlete was having a difficult time even making it to classes, so that became a big decision for us as well.	
Length of recovery	That was her fourth concussion in 3 years, and she was having symptoms for a year postinjury so she actually is the one who decided she wanted to medically disqualify herself.	

Participants described that the overall number of concussions sustained played a role in their MDQ following concussion decision-making process. One participant noted that the number one factor that contributed to their decision was "the number of concussions that the student-athlete has sustained, both within a set time frame and over the course of their lifetime."

Participants did not always have a set number of concussions necessary to have a discussion; however, others did, noting, "I've always been told 3. That's what it was at one of the schools I was at, it was after 3, we need to have a discussion with the physician to determine if this is really safe for that athlete."

Other factors that participants described were long-term health consequences and future well-being. One participant noted, "It's overall health and well-being and his well-being in the future that led us to disqualify him." One other participant described specific medical conditions:

We talk about looking at the football players and when we look at these guys that have CTE [chronic traumatic encephalopathy], this is the concern and potentially the direction that you're headed of like early onset Alzheimer's. Tell them, you need to think long and hard about what your goals are. Do you love lacrosse, as much as you love walking and breathing, and as much as you love anything else in life, because if lacrosse is your number one thing in life right now then that's your choice. If there are other things in life that you enjoy and you are looking down the road as a 20 year old or 22 year old and 18 year old, looking at your life, do you want to have children, do you want a family, do you want to live past 50? I'm pretty blunt in having those conversations to say no one thinks that it can happen to them, but it can. You need to just think about it. Do your own research. Talk to our team doctors. We'll set you up with a neurology consult if you want that. Let you make your decision.

A patient's overall health-related quality of life also played a role in the MDQ following concussion decision-making process. One participant described, "...One of the things is quality of life for the student-athlete after they finished playing, you know, where they're going to be 10, 20, 30, 40 years from now."

Participants also described symptom severity as a factor, saying that MDQ should be considered "if the athlete is still kind of like my athlete where they're struggling with their symptoms a little bit, they're still taking the medication, they can't do exercises because they're having symptoms."

Concussion disclosure was a subtheme from our findings in participants recounting how that factored into the MDQ decision-making process: And then the case we're working with now, I can pretty confidently say that this was mismanaging in high school and probably due to a lack of patient reporting and athletic training coverage.

Participants not only noted concussion disclosure when seeking care for the current concussion but also how disclosure plays a role in the overall number of concussions disclosed, saying,

There's kids that [say], "well I've heard of somebody being told they couldn't play because they've had too many, so instead of saying I had 6, I'm going to say I only had 2." That's when the process gets really tricky.

Several participants discussed the role of academics. One participant noted,

They were still having symptoms and struggling with school. We decided to medically disqualify with the decision as well from the student-athletes due to having—they weren't able to fully attend school. They actually had to withdraw from school for at least a year, and when they came back to school, they did not participate anymore in the sport.

Last, the length of recovery was an indicator that MDQ may be considered. This participant described the length of recovery for each successive injury:

We had a particular athlete that, you know, every time he sustained a concussion, symptoms lasted longer and longer and longer. And so the first time, he might have last 1 day and second time they might last a week and then the third time they might last 3 weeks, whatever it may be. So, at that point time, you're seeing that pattern of [concussions] being more severe. So you start having that conversation with him of, "Is this the best thing for you?"

DISCUSSION

The aims of this study were 3-fold: (1) describe the MDQ following concussion cases ATs have been involved in, (2) describe the beliefs of the AT regarding MDO following concussion, and (3) explore the factors ATs believed should be involved in the MDQ following concussion process. Deciding MDQ or retirement from sport following concussion is a difficult decision sport medicine professionals face, often with limited evidence to inform decisions. Our results indicate that, regardless of the available evidence, nearly half of our sample was involved in MDQ following concussion, and of those, the average number of MDO cases encountered was 2. Additionally, participants interviewed generally had more years of experience, managed more concussions annually, and had more involvement in MDQ cases following concussion than the surveyed sample. Participants believed that many factors should be considered in the MDQ decision-making process, including sport contact level, concussion history, future wellbeing, and how the injury impacted the patient's current life aspects, such as quality of life and academics.

The decision to stop sports participation following concussion has been historically rooted in a 3-strike rule first described by Thorndike in 1953.²⁵ The 3-strike rule has continued to be an accepted criteria for MDQ following concussion even though its roots are in expert opinion and not empirical data.⁸ The acknowledgement of the 3-strike rule was also apparent in our findings, with participants describing that patients may not be truthful of a third concussion to health care providers and therefore only state a concussion history of 2. However, ATs described an average of 4.6 concussions in the self-reported data of how many concussions had been experienced by each patient. Additionally, respondents noted that they believed that 5 concussions were too many before MDQ should be considered. From the available literature, athletes themselves reported that they would retire from sport participation after 3 or 4 concussions.²⁶ Currently there is no threshold for concussive injuries when considering an athlete for MDQ. Clinicians, like those described in our sample, should consider each patient individually and holistically with a variety of factors to determine if sport participation is no longer safe for an athlete following concussion.

The current literature cites that no evidence exists to recommend an absolute indicator for retirement or MDQ from sport participation following concussion.²⁷ Collectively, we offer 8 factors that may influence cessation of sport participation following concussion as guided by the existing literature and our findings, including (1) concussion history, (2)persistent diminished academic or workplace performance, (3) persisting concussion symptoms, (4) structural abnormalities in neuroimaging, (5) prolonged recovery, (6) perceived reduced threshold of sustaining recurrent concussions, (7) psychosocial factors, and (8) future risk considerations.⁴ Results from our study mirrored several of these factors to consider in the MDQ decision-making process, including concussion history, impact on academic performance, sportspecific factors, and recovery length. Additionally, Makdissi et al recommend an interprofessional approach, including input from the individual, parents/guardians, health care professionals, and school personnel, when necessary.²⁷ This was also corroborated in our results, as the most frequent individual involved in MDO following concussion was the patient, followed by various health care professionals and parents/ guardians. Makdissi et al also states that the final decision for MDO is up to the patient and/or their parent/guardian, especially because the autonomy of an MDQ decision was shown to be associated with lower levels of anxiety and depression later.^{27,28} Interestingly, athlete preference was rated frequently and with high importance in the MDQ decision from our sample, and nearly 50% of our sample believed parents/guardians should be involved. Unfortunately, it is not always a viable option to incorporate athlete preference given institutional risk and policies; however, having collective conversations with the patient and many individuals important to the patient where information is presented and questions are answered may create a seemingly shared decision. Recommendations from Makdissi et al were recently published in 2023 and seem to be contrary to our findings; therefore, future research should continue to examine perceptions of who should be involved in the MDQ decision-making process following concussion, roles and responsibilities, how they should be consulted, and, importantly, the weight of those views.²⁷

Several resources are available to help clinicians obtain information and support the patient following their MDQ decision. Patient-reported outcomes can be useful to gain objective information to aid in the decision-making process and, once the decision has been made, to medically disqualify.

The information obtained in patient-reported outcomes could help initiate conversations and provide objective data to present to the patient when MDO is considered. Especially because athletic identity is high in athletes, it may be difficult to stop sport participation. Patient-rated outcomes can also assist clinicians to ensure support even after the decision has been made. Supporting self-acceptance and reframing interests may also assist in restricting views high in athletic identity and ensure that new goals and career planning offer new directions.^{29,30} Other resources like Sidelined.org provide other support resources for patients who have been medically disqualified with a support network. Clinicians can also consider if the patient may be involved in other potentially lower-risk sports or have a different role within their current team to enhance social connection and belonging. DeFreese et al found that having no transition plan following sport participation discontinuation was associated with higher depression and anxiety levels in former athletes.²⁸ Given this, it is imperative to support the patient not only during the MDQ decision-making process but also in the transition from sport participation.

Limitations and Future Research

There are limitations to our study. Responses from our study are not generalizable to those who did not complete the survey or interview. Additionally, although the current literature suggests that patients drive the MDQ decision-making process following concussion, our results presented views from clinicians only.²⁷ Future research should continue to examine the longterm health consequences and outcomes of concussion, examine MDQ practices among clinicians while incorporating the patient perspectives of those who have been medically disqualified following concussion, and examine why certain individuals should be involved in this process over others. As this study was only completed in health care professionals at the collegiate setting, future research should examine MDO following concussion at other levels, which likely will change the frequency of involvement of individuals, especially parents/guardians. Last, many of our multiselect survey items did not contain a "none" item response, which may have forced participants to skip the item; however, we believe that our results are still important to present, as limited information on this topic exists. Future studies should include a "none" item response to capture this.

CONCLUSIONS

Deciding when sport participation is no longer viable is a difficult decision with limited evidence to guide patient and clinician decisions. However, our results indicate that numerous clinicians are embarking on this process and considering multiple factors to guide their decision in conjunction with multiple partners. Clinicians believed sport contact level, concussion history and recovery length, and the patient's overall well-being, including health-related quality of life and academic performance, should be considered in the MDQ following concussion decision-making process. These findings along with others presented here can be used to assist clinicians in the MDQ following concussion decision with consideration of patient preference if feasible. Future research should continue to examine MDQ following concussion, especially to incorporate the patient perspective.

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SUPPLEMENTAL MATERIAL

Supplemental Table. Medical Disqualification Following Concussion Survey^a

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